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METHOD AND DEVICE FOR MANUFACTURING LIQUID CRYSTAL PANEL

[Abstract]

PROBLEM TO BE SOLVED: To provide a method for manufacturing a liquid crystal panel by which a sealing material can be satisfactorily cured by using a simple apparatus and the reduction of the reliability of the liquid crystal panel due to insufficient curing of the sealing material can be prevented.

SOLUTION: The apparatus can be simplified by performing scanning with UV rays made to be parallel light beams along the sealing material 6 to cure the sealing material 6 after the liquid crystal panel is filled with a liquid crystal by a dripping method and two substrates are stuck to each other.

[Claim(s)]

[Claim 1] A method of fabricating a liquid crystal panel characterized by including the steps of: forming a seal material at a predetermined position, on one substrate of a pair of substrates; joining the substrate on which the seal material is formed with another substrate; and curing the seal material by scanning ultraviolet rays made to be a parallel light depending on the seal material.

[Claim 2] The method according to claim 1 wherein the step of curing the seal material is performed by a mask shielding of the ultraviolet rays in at least the liquid crystal display portion of a joined substrate.

[Claim 3] The method according to claim 1 or 2 wherein the step of curing the seal material is performed while changing an irradiation angle of the ultraviolet rays.

[Claim 4] A method of fabricating a liquid crystal panel characterized by including the steps of: forming a UV curable seal material at a predetermined position with a drawing by a screen print dispenser, on one substrate of a pair of electrode-attached substrates to be aligned; arranging a spacer material on another substrate for controlling a gap between two sheets of substrates; dropping a predetermined amount of liquid crystal material within

an area enclosed with the seal material of the substrate in which the seal material is formed, using a predetermined pattern of a liquid discharging device; aligning the substrate in which the liquid crystal material is dropped and the substrate on which the spacer material is arranged; joining the two sheets of substrates in vacuum, and then performing a pressing, and spreading the liquid crystal and compressing the seal material and forming a uniform gap; and masking a portion except the seal portion of the joined substrates, and scanning the ultraviolet ray depending on the seal material and curing the seal material.

[Claim 5] A method of fabricating a liquid crystal panel characterized by including: a source of light for irradiating ultraviolet rays on a substrate; a convex lens for making the ultraviolet rays into parallel light; a three axis direction position control means for freely moving a source of light and the convex lens in three axis directions; and a stage for mounting the substrate.

[Claim 6] The device according to claim 5 characterized by including a filter in a midstream of an ultraviolet irradiation axis line, wherein the filter shields a wavelength area in which the liquid crystal material absorbs the ultraviolet rays, in a wavelength area of the ultraviolet rays.

[Claim 7] The device according to claim 5 or 6 characterized by including

a translucency mirror of a rotatable material that can change an irradiation angle of the ultraviolet rays, in the midstream of the ultraviolet irradiation axis line.

[Claim 8] The device according to claim 5 or 6 characterized by including an optical fiber enabling to change an irradiation angle of the ultraviolet rays.

[Title of the Invention]

METHOD AND DEVICE OF FABRICATING A LIQUID CRYSTAL PANEL

[Detailed Description of the Invention]

[Field of the Invention]

The invention relates to a method and a device of fabricating a liquid crystal panel that can be used as a display device of electronic equipment.

[Description of the Prior Art]

Largely, there are two kinds of methods of fabricating the liquid crystal display device. One is vacuum injection method, and another is drip method. The former injection method is that a seal material is formed to be a predetermined pattern using a screen printing dispenser on at least one substrate of a pair of electrode-attached substrates to be aligned, a spacer material is formed on another substrate, these two sheets of substrates is joined and pressed so that the seal material is pressed, and then, the seal material is cured by a ultraviolet ray or heating, wherein the seal material is a heat curable type, a ultraviolet curable type or a combination of the ultraviolet curable type and the heat curable tape. Subsequently, by dividing and cutting a glass such that a required terminal portion remain, cell is produced, a liquid

crystal inlet formed in cell with a cell interior being a decompression state is contacted with the liquid crystal, and then, by pressing the atmosphere, the liquid crystal is filled in the cell.

In this vacuum injection method, a time which the injection is finished is largely restricted due to a size of the liquid crystal panel, since a time filling the liquid crystal in the cell uses a capillary tube phenomenon of the liquid crystal. Thus, it is very difficult to manage it as a production line.

There is a drop method as a method of fabricating the liquid crystal panel to solve these problems. This drop method can control the filling time of the liquid crystal regularly, regardless of the size of the panel, by mechanically dropping and providing the liquid crystal of a necessary amount within an area of the seal material formed on one substrate of a pair of substrate. Thus, productivity can be improved remarkably.

[Problem(s) to be Solved by the Invention]

As such, the drop method is stable in the filling time of the liquid crystal and can construct a line with a high productivity, compared to the vacuum injection method. However, in the drop method, after the liquid crystal is dropped within an area enclosed with the seal material formed on the substrate, the liquid crystal material is contacted with an uncured seal

material in order to join a pair of substrates in vacuum. In this time, since it is required to cure the seal material quickly in order to prevent a component forming the seal material from flowing into the liquid crystal, the curable type by the ultraviolet ray is used.

Typically, an ultraviolet curable seal material uses an acrylate metacrylate-based resin as a main component, and the ultraviolet wavelength area on the order of 200 nm to 400 nm, irradiation energy above 3000 mJ/cm^2 and an intensity of irradiation of the source of light above 10 mW/cm^2 uses to cure this resin.

As a method for irradiating the ultraviolet ray on the seal material, there is a method which a portion except the seal material portion is masked, the ultraviolet ray is irradiated from an upper side of the mask on the overall substrate all at once. In this time, a scattering light of the ultraviolet ray is used, so that the intensity of irradiation of the ultraviolet ray is uniform within a surface. In the case that the scattering light is used, the ultraviolet ray enters even inside of the mask so that the ultraviolet ray is irradiated even on the display portion. As a result, a material constituting the liquid crystal, i.e. an alignment film, a liquid crystal material and a transistor is deteriorated so that a display grade is degraded.

While it is available means to make the ultraviolet ray to be a parallel light to solve this problem, since it is required to use a fly eye lens in the case that is intended to make the ultraviolet ray to be a parallel light, etc., a scale of an optical system become large. Particularly, since a size of the substrate become large, it is difficult to equip it.

Moreover, since an electrode portion consists of a metal in a reflecting type or a TFT-formed substrate, the ultraviolet ray is shielded completely. Due to this, since in the case of the parallel light, the light do not enter the seal material portion located below the electrode so that the seal material can not be cured sufficient, a deterioration of the seal material is generated, for example, an uncured component of the seal material flow into the liquid crystal under a high temperature circumstance and a moisture dopes into liquid crystal under a high moisture circumstance, and a reliability of the liquid crystal panel is remarkably degraded.

To solve these problems, it is an object of the invention to provide a method and a device of fabricating a liquid crystal panel in which it is possible to cure the seal material sufficiently with simple and easy equipment and to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

[Means for Solving the Problem]

To solve these problems, a method of fabricating the liquid crystal panel described in claim 1 includes a step forming the seal material at a predetermined position, on one substrate of a pair of substrates; joining the substrate on which the seal material is formed with another substrate; and curing the seal material by scanning the ultraviolet ray made to be a parallel light depending on the seal material.

According to the invention described in claim 1, since by scanning the ultraviolet ray made to be the parallel light depending on the seal material, it is possible to cure the seal material sufficiently with a simple and easy equipment compared to a conventional fabrication method of large scale, it is possible to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material. Moreover, since the equipment is simple and easy, it is possible to save a space.

The method of fabricating the liquid crystal panel described in claim 2 is characterized in claim 1 by the step curing the seal material perform a mask shielding the ultraviolet ray in at least the liquid crystal display portion of a joined substrate.

According to the invention described in claim 2, in addition to the

effect of the invention described in the claim 1, it is possible to prevent the ultraviolet ray to be irradiated on a liquid crystal display portion, since at least the liquid crystal display portion of the joined substrates is masked.

The method of fabricating the liquid crystal panel described in claim 3 is characterized in claim 1 by the step curing the seal material is performed while changing an irradiation angle of the ultraviolet ray.

According to the invention described in claim 3, in addition to the effects of the invention described in the claim 1 or 2, by changing the irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material located below the electrode of metal material that is mounted to a reflecting type liquid crystal panel or a TFT-formed liquid crystal panel, etc. As a result, although the ultraviolet ray made to be the parallel light is used, it is possible to cure the seal material located below the electrode of metal material sufficiently. Thus, it is possible to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

A method of fabricating the liquid crystal panel described in claim 4 includes step forming the UV curable seal material at a predetermined position with a drawing by a screen print dispenser, on one substrate of a

pair of electrode-attached substrates to be aligned; arranging a spacer material for controlling a gap between two sheets of substrates on another substrate; dropping a predetermined amount of a liquid crystal material within area enclosed with the seal material of the substrate in which the seal material is formed, using a predetermined pattern of a liquid discharging device; aligning the substrate in which the liquid crystal material is dropped and the substrate on which the spacer material is arranged; joining the two sheets of substrates in vacuum, and then performing a pressing, and spreading the liquid crystal and compressing the seal material and forming a uniform gap; and masking a portion except the seal portion of the joined substrates, and scanning the ultraviolet ray depending on the seal material and curing the seal material.

According to the invention described in claim 4, since by scanning the ultraviolet ray made to be a parallel light depending on the seal material, it is possible to cure the seal material sufficiently with simple and easy equipment compared to the conventional fabrication method of large scale, it is possible to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

A method of fabricating the liquid crystal panel described in claim 5

includes a source of light for irradiating an ultraviolet ray on a substrate; a convex lens made the ultraviolet ray to be a parallel light; a three axis direction position control means for freely moving the source of light and the convex lens in three axis directions; and a stage for mounting the substrate.

According to the invention described in claim 5, since by including the three axis direction position control means freely moving the source of light and the convex lens in the three axis directions, it is possible to scan the ultraviolet ray made to be a parallel light depending on the seal material, it is possible to cure the seal material sufficiently with a simple and easy equipment compared to a conventional fabrication method of large scale. As a result, it is possible to provide the device of fabricating the liquid crystal that can avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material. Moreover, since the equipment is simple and easy, it is possible to provide the device of fabricating the liquid crystal that can save a space.

The device of fabricating the liquid crystal panel described in claim 6 is characterized in claim 5 by including a filter in a midstream of the ultraviolet irradiation axis line, wherein the filter shields a wavelength area in which the liquid crystal material absorb the ultraviolet ray, in a wavelength

area of the ultraviolet ray.

According to the invention described in claim 6, in addition to the effect of the invention described in the claim 5, by including the filter for shielding the wavelength area in which the liquid crystal material absorbs the ultraviolet ray, it is possible to provide a device of fabricating the liquid crystal that can avoid a light deterioration of the liquid crystal panel even in the case that the ultraviolet ray is irradiated on the liquid crystal material.

The device of fabricating the liquid crystal panel described in claim 7 is characterized in claim 5 or 6 by including a translucency mirror of a rotatable material that can change an irradiation angle of the ultraviolet ray, in the midstream of the ultraviolet irradiation axis line.

According to the invention described in claim 7, in addition to the effect of the invention described in the claim 5 or 6, by including the translucency mirror of the rotatalbe material that can change an irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material located below the electrode of metal material. As a result, it is possible to cure the seal material located below the electrode of metal material. Thus, it is possible to provide the device of fabricating the liquid crystal panel that can avoid the reliability deterioration of the liquid crystal

panel due to an insufficient curability of the seal material.

The device of fabricating the liquid crystal panel described in claim 7 is characterized in claim 5 or 6 by including an optical fiber enabling to change an irradiation angle of the ultraviolet ray.

According to the invention described in claim 8, in addition to the effect of the invention described in the claim 5 or 6, by including the optical fiber enabling to change an irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material located below the electrode of metal material. As a result, it is possible to cure the seal material located below the electrode of metal material. Thus, it is possible to provide the device of fabricating the liquid crystal panel that can avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

[Embodiment of the Invention]

(A first embodiment)

A first embodiment of the invention is described with reference to drawings. Fig. 1 is a schematic diagram of an ultraviolet irradiating process showing the first embodiment of the invention. A source of light emitting the ultraviolet is 2, a convex lens using the ultraviolet ray as a parallel light is 3, a

cutoff filter absorbing a wavelength area(generally below 330 nm) of the ultraviolet ray that is absorbed by the ultraviolet ray is 11, a optical fiber irradiating the irradiation, that is the parallel light, to subject is 4, a three axis direction position control device freely moving the source of light 2, the convex lens 3, the optical fiber 4, the cutoff filter 11 in three axis directions is 1, a light-shielding mask shielding the ultraviolet ray is 5, a seal material sealing a liquid crystal is 6, a glass substrate is 7, an alignment film is 8, the liquid crystal is 9, a liquid crystal panel consisted of the seal material 6, the glass substrate 7 and the liquid crystal 9 is 12, and a stage mounting the liquid crystal panel 12 is 10.

The liquid crystal 12 is fabricated, for example, by forming the seal material 6 of UV curable type at a predetermined position with a drawing by a screen print dispenser, on one substrate of a pair of substrates to be aligned, arranging a spacer material on another substrate. And a liquid crystal material 9 is dropped within an area enclosed with the seal material 6 in one substrate, the substrate is joined with the substrate in which the spacer material is arranged and pressing it. Then, the liquid crystal panel 12 is mounted on the stage 10, and an ultraviolet irradiating process described below is performed.

The three axis direction position control device 1(for example, XYZ movable robot), with the source of light 2, the convex lens 3 and the optical fiber 4 being fixed, is operated depending on a pattern of the seal material 6. In other words, an emitting portion of the optical fiber 4 is moved, and the ultraviolet ray is irradiated vertically on the seal material 6 of the liquid crystal panel, with the light-shielding mask 5 being laid between the optical fiber 4 and the seal material. Moreover, it is preferable that a spot diameter of the ultraviolet ray being irradiated on the seal material 6 is below a distance from the seal material 6 to display area, and it is typically below Φ2 mm.

Here, a diameter of the optical fiber 4 has been Φ30 mm, and an intensity of irradiation of the source of light 2 above a 10 mW/cm^2 has been typically used, while an intensity of irradiation of light irradiated from the optical fiber 4 has been used as a 100 mW/cm^2 in this embodiment. Moreover, the source of light 2 is high pressure mercury lamp. A wavelength of this lamp has a strong peak even in area below 330 nm that is a wavelength area being absorbed by the liquid crystal, and the cutoff filter 11 for cutting off a wavelength area below the 330 nm is inserted, in front of the convex lens 3. Moreover, acrylate-based metaacrylate-based resins can be used as the seal material 6 of an ultraviolet curable type, while the seal material 6 used in this embodiment is acrylate-based resin and energy required to cure it has been

$3000 mJ/cm^2$. Accordingly, a moving speed of the optical fiber 4 is to be 1 mm/s.

Under this ultraviolet irradiating device and irradiating condition, the seal material 6 of the liquid crystal panel 12 fabricated by joining 2 sheets of the substrate on which the liquid crystal is dropped has been cured. The liquid crystal panel 12 fabricated as such is the liquid crystal panel of simple matrix type, and is constituted of the glass substrate 7 forming a pair of polyimides-based alignment film 8, the nematic liquid crystal material 9, the seal material 6, and a transparent electrode (not shown), wherein a line width of the seal material 6 is 1±0.2 mm. Since the transparent electrode transmits the ultraviolet ray, the ultraviolet ray is also irradiated on the seal material 6 below the transparent electrode.

Here, a portion of the seal material 6 that is not covered by the light-shielding mask 5 has been to be 2 mm. Accordingly, the ultraviolet ray is irradiated on an area of 0.4 to 0.5 mm in the liquid crystal material. However, due to an effect of the cutoff filter 11, the liquid crystal is not deteriorated. What a distance from an edge of the seal material 6 to a display pixel is 1 mm also do not effect on display portion under a current conditions. Accordingly, the liquid crystal panel having good display grade can be provided.

(A second embodiment)

Next, a second embodiment of the invention is described with reference to drawings. Fig. 2 is a schematic diagram of an ultraviolet irradiating process showing the second embodiment of the invention. The second embodiment is same as the first embodiment in 1 to 12. A translucency mirror that enables to change an irradiation angle of the ultraviolet ray is 21

The liquid crystal panel 12 fabricated as described in the first embodiment is mounted on the stage 10, and an ultraviolet irradiating process described below is performed.

The ultraviolet ray irradiated from the source of light 2 on the three axis direction position control device 1(for example, XYZ movable robot) is made to be the parallel light by means of the convex lens 3, and the optical fiber 4 for irradiating the light on subject portion is fixed, and the translucency mirror 21 is inserted in the middle of the light-shielding mask 5 and a irradiation portion of the optical fiber, and a vertical light from the optical fiber 4 and a light reflected by the translucency mirror 21 is irradiated on the seal material 6 of the liquid crystal panel 12 with the light-shielding mask 5 being laid between the seal material 6 and the irradiation portion of

the optical fiber. And, the XYZ movable robot is operated depending on the pattern of the seal material 6, the irradiation portion of the optical fiber 4 is scanned. Moreover, it is preferable that a spot diameter of the ultraviolet ray being irradiated on the seal material 6 is below a distance from the seal material 6 to display area, and it is below typically Φ2 mm.

Here, a diameter of the optical fiber 4 has been Φ30 mm, and the intensity of irradiation of the source of light 2 above 10 mW/cm^2 has been typically used, while the intensity of irradiation of light irradiate from the optical fiber 4 has been used as 100 mW/cm^2 in this embodiment. Moreover, the source of light 2 is high pressure mercury lamp. Since a wavelength of this lamp has a strong peak even in area below 330 nm, the cutoff filter 11 cutting off a wavelength area below the 330 nm is inserted, in front of the convex lens 3. Moreover, the seal material 6 used is acrylate-based resin and energy required to cure it has been 3000mJ/cm^2. Accordingly, a moving speed of the optical fiber 4 has been to be 0.5 mm/s.

Under this ultraviolet irradiating device and irradiating condition, the seal material 6 of the liquid crystal panel 12 fabricated by joining 2 sheets of the substrate on which the liquid crystal is dropped has been cured. The liquid crystal panel 12 fabricated as such is constituted of the glass substrate

7 forming an alignment film 8 of a pair of polyimides-based, the nematic liquid crystal material 9 and the seal material 6, wherein a line width of the seal material 6 is 1±0.2 mm. And, an electrode 31 of metal material that is mounted in the liquid crystal panel, etc. is arranged on a portion of the seal material 6, as shown in Fig. 3. A width of the electrode 31 of metal material is 30μm, and a width between a pair of substrates in the liquid crystal panel 12 is 5 μm. Accordingly, an angle θ of a gradient of the translucency mirror 21(Fig. 5) is to be 9° against a proceeding direction of the light, and the angle θ of a gradient of the translucency mirror 21 is changed by the width of the electrode 31 of metal material during irradiating. Thereby, the ultraviolet ray is also irradiated to the seal material 6 below the electrode 31 of metal material as shown in Fig. 5. Moreover, while in the seal material 6, a non-irradiated portion 41 is generated, since a radical generated in irradiation portion is transferred up to the non-irradiated portion 41, the seal material 6 is cured even in the non-irradiated portion 41, as shown in Fig. 5.

The liquid crystal panel 12 fabricated in a condition described above has not been deteriorated in the display grade around seal for 1000 hours, under a reliability test of 120° C, and a high temperature and a high humidity test of 60° C and 90%.

(A third embodiment)

Finally, a third embodiment of the invention is described with reference to drawings. Fig. 4 is a schematic diagram of an ultraviolet irradiating process showing the third embodiment of the invention. The third embodiment is same as the first embodiment in 1 to 12, while an irradiation angle of the optical fiber 4 is changed freely in this embodiment.

The liquid crystal panel 12 fabricated as described in the first embodiment is mounted on the stage 10, and an ultraviolet irradiating process described below is performed.

The ultraviolet ray irradiated from the source of light 2 is made to be the parallel light by means of the convex lens 3, and is passed through the optical fiber 4 to irradiate the light to the seal material 6. This optical fiber is fixed inclined with only predetermined degree, the light passing through the optical fiber 4 is irradiated to the seal material 6 of the liquid crystal panel 12 with the light-shielding mask 5 being laid between the seal material of the liquid crystal panel and the optical fiber. And, the three axis direction position control device 1(for example, XYZ movable robot) is operated depending on the pattern of the seal material 6, the irradiation portion of the optical fiber 4 is moved. Moreover, it is preferable that a spot diameter of the ultraviolet ray

being irradiated on the seal material 6 is below a distance from the seal material 6 to display area, and it is below typically Φ2 mm.

Here, a diameter of the optical fiber 4 has been Φ30 mm, and the intensity of irradiation of the source of light 2 above 10 mW/cm^2 has been typically used, while the intensity of irradiation of light irradiate from the optical fiber 4 has been used as 100 mW/cm^2 in this embodiment. Moreover, the source of light 2 is high pressure mercury lamp. Since a wavelength of this lamp has a strong peak even in area below 330 nm, the cutoff filter 11 cutting off a wavelength area below the 330 nm is inserted, in front of the convex lens 3. Moreover, the seal material 6 used is acrylate-based resin and energy required to cure it has been 3000mJ/cm^2. Accordingly, a moving speed of the optical fiber 4 is to be 0.5 mm/s.

Under this ultraviolet irradiating device and irradiating condition, the seal material 6 of the liquid crystal panel 12 fabricated by joining 2 sheets of the substrate on which the liquid crystal is dropped has been cured. The liquid crystal panel 12 fabricated as such is the liquid crystal panel of simple matrix type, and is constituted of the glass substrate 7 forming an alignment film 8 of a pair of polyimides-based, the nematic liquid crystal material 9 and the seal material 6, wherein a line width of the seal material 6 is 1±0.2 mm.

And, an electrode 31 of metal material that is mounted in a liquid crystal panel of a reflectable type or a liquid crystal panel forming a TFT, etc. is arranged on a portion of the seal material 6, as shown in Fig. 3. A width of the electrode 31 of metal material is 30μm, and a width between a pair of substrates in the liquid crystal panel 12 is 5 μm. Accordingly, an angle θ of a gradient of the translucency mirror 21(Fig. 5) is to be 9° against a vertical direction to the substrate, and the angle of a gradient of the optical fiber is changed by the width of the electrode 31 of metal material during scanning. Thereby, the ultraviolet ray is also irradiated to the seal material 6 below the electrode 31 of metal material as shown in Fig. 5. Moreover, while a non-irradiated portion 41 is generated, since a radical generated in irradiation portion is transferred up to the non-irradiated portion 41, the seal material 6 is cured even in the non-irradiated portion 41, as shown in Fig. 5.

The liquid crystal panel 12 fabricated in a condition described above has not been deteriorated in the display grade around seal for 1000 hours, under a reliability test of 120°C, and a high temperature and a high humidity test of 60°C and 90%.

Since the ultraviolet ray is scanned depending on the seal material 6 in the first to third embodiments, as shown in Fig. 1, Fig. 2 and Fig.4, it is

possible to cure the seal material 6 sufficiently with a simple and easy ultraviolet irradiating device spot irradiating the ultraviolet ray. Moreover, since the ultraviolet irradiating device is simple and easy, it is possible to save a space. In the first and second embodiments, it is also possible to cure the seal material 6 below the electrode 31 of metal material sufficiently.

Moreover, while a diameter of the optical fiber 4 has bee Φ30 mm in the first to third embodiments, this diameter of the optical fiber 4 can be changed optionally in case that the light-shielding mask 5 is mounted as in said embodiments. Moreover, if the diameter of the optical fiber 4 is below Φ2 mm, the light-shielding mask 5 is not required. Here, by making the diameter of the optical fiber 4 to be a small spot diameter below 2 mm or using the light-shielding mask 5, it is possible to prevent the alignment film 8 of a display area or transistor (not shown), etc. from being deteriorated. Moreover, a scanning direction of the light can be reciprocated to cure the seal material 6 more sufficiently. Moreover, while the cutoff filter 11 is inserted in front of the convex lens 3 in the first to third embodiments, the cutoff filter 11 can be inserted between the optical fiber 4 above the light-shielding 5 and the light-shielding 5.

[Effect of the Invention]

According to the invention described in claim 1, since by scanning the ultraviolet ray which is made to be a parallel light depending on the seal material, it is possible to cure the seal material sufficiently with a simple and easy equipment compared to a conventional fabrication method of large scale, it is possible to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material. Moreover, since the equipment is simple and easy, it is also possible to save a space.

According to the invention described in claim 2, in addition to the effect of the invention described in the claim 1, it is possible to prevent the ultraviolet ray to be irradiated on a liquid crystal display portion, because of masking at least the liquid crystal display portion to the joined substrates.

According to the invention described in claim 3, in addition to the effects of the invention described in the claim 1 or 2, by changing the an irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material located below the electrode of metal material. As a result, although the ultraviolet ray made to be the parallel light is used, it is possible to cure the seal material located below the electrode of metal material. Thus, it is possible to avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

According to the invention described in claim 4, by scanning the ultraviolet ray on the seal material, it is possible to fabricate the liquid crystal panel a simply and easily compared to the conventional fabrication method of large scale.

According to the invention described in claim 5, by including the three axis direction position control means freely moving the source of light and the convex lens in the three axis directions, it is possible to implement simple and easy equipment. Moreover, because equipment is simple and easy, it is possible to provide a device of fabricating the liquid crystal panel that can save a space.

According to the invention described in claim 6, in addition to the effect of the invention described in the claim, by including the filter for shielding a wavelength area in which the liquid crystal material absorbs the ultraviolet ray, it is possible to provide a device of fabricating the liquid crystal panel which a light deterioration of the liquid crystal pane can be avoided even in the case that the ultraviolet ray is irradiated on the liquid crystal material.

According to the invention described in claim 7, in addition to the effect of the invention described in the claim 5 or 6, by including the

translucency mirror of a rotatable material that can change an irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material below the electrode of metal material. As a result, it is possible to cure the seal material located below the electrode of metal material. Thus, it is possible to provide the device for fabricating the liquid crystal panel that can avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

According to the invention described in claim 8, in addition to the effect of the invention described in the claim 5 or 6, by including the optical fiber enables to change an irradiation angle of the ultraviolet ray, it is possible to irradiate the ultraviolet ray even on the seal material located below the electrode of metal material. As a result, it is possible to cure the seal material located below the electrode of metal material. Thus, it is possible to provide the device for fabricating the liquid crystal panel that can avoid the reliability deterioration of the liquid crystal panel due to an insufficient curability of the seal material.

[Description of Drawings]

Fig. 1 is a schematic diagram showing an ultraviolet curability of the seal material in a first embodiment of the invention.

Fig. 2 is a schematic diagram showing an ultraviolet curability of the seal material in a second embodiment of the invention.

Fig. 3 is a diagram showing an upper side of the liquid crystal panel having the electrode of metal material.

Fig. 4 is a schematic diagram showing an ultraviolet curability of the seal material in a third embodiment of the invention.

Fig. 5 is schematic diagram showing a non-irradiated portion in the second embodiment of the invention.

[A description of sign]

1: a three axis direction position control device

2: a source of light of the ultraviolet ray

3: a convex lens

4: a optical fiber

5: a light-shielding mask

6: a seal material

7: a glass substrate

8: an alignment film

9: a liquid crystal material

10: stage

11: a cutoff filter for cutting off a wavelength below 330 nm

12: a liquid crystal panel

21: translucency mirror

31: an electrode of metal material

41: a non-irradiated portion